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ABSTRACT

This report presents the findings and implications of some research on the relationships of some educational inputs and reading performance of disadvantaged California Title I pupils which utilized a highly simplified model of the compensatory education process. The data for the study were gathered by questionnaire administered in personal interviews to a six percent sample of California Title I projects, enrolling ten percent of California Title I students. All projects in the study used the same performance measure, the Stanford Reading Test. Information was gathered and used for pupils in four elementary grades. The instructional variable which is most consistently and dependably related to reading gains was that for the trained reading specialist. Specialist instruction was the only school input related to reading performance in the third grade considered separately, with the strength of the relationship even stronger in that grade than in the four pooled grades. While the variables for instruction by professionals were less statistically significant, they showed signs of having some importance. Of the variables constructed to measure planning and coordination, only that for hours of planning itself was related to performance.
(Author/JM)

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SOME ESTIMATES FOR THE COST EFFECTIVENESS OF EDUCATIONAL INPUTS FOR READING PERFORMANCE OF DISADVANTAGED CHILDREN IN CALIFORNIA TITLE I PROJECTS

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March 1972

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ERRATA

P-4847 SOME ESTIMATES FOR THE COST EFFECTIVENESS OF EDUCATION INPUTS FOR READING PERFORMANCE OF DISADVANTAGED CHILDREN IN CALIFORNIA TITLE 1 PROJECTS, by Herbert J. Kiesling, dated March 1972

Page 4, 12th line from the top

"and typically could not devote" should read:
"and typically could only devote."

Page 8,

Table 1, first figure, first column should read:

.076 months and not .76 months

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SOME ESTIMATES FOR THE COST EFFECTIVENESS OF EDUCATIONAL INPUTS FOR READING PERFORMANCE OF DISADVANTAGED CHILDREN IN CALIFORNIA TITLE I PROJECTS

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INTRODUCTION

In a recently published Rand research report,[1] the author presented relationships of some educational inputs and reading performance of disadvantaged California Title I pupils which utilized a highly simplified model of the compensatory education process. This paper is meant to give some extensions of those findings including some cost imputations. It is meant to be helpful to practicing educational managers of compensatory education programs as well as to researchers. The numbers given are defended as being no more than highly suggestive.

In order to prevent the reader from being required to read the original report, the model and data used are summarized briefly in the first section. The basic hypotheses tested and findings are also given before some additional findings and cost relationships are presented.

SUMMARY OF DATA, VARIABLES, AND WORKING HYPOTHESES

The data for the study were gathered by questionnaire administered in personal interviews to a six-percent sample of California Title I projects,[2] enrolling ten percent of California Title I students. All projects in the study used the same performance measure, the Stanford Reading Test. Information was gathered and used for pupils in four elementary grades.

The following four hypotheses make up the basic framework or "model" about which the study was designed.

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(1) *The more minutes of instruction the pupil receives, the more he learns.*

(2) *Instructional specialists, trained as they are in diagnostic individualized instruction techniques, are likely to be more effective in teaching reading, per minute of instruction, than other teaching personnel.*

(3) *Pupils learn more in programs in which diagnostic, instructional, evaluation, and administrative personnel are well coordinated concerning objectives.*

(4) *Since differences in the family life style of the pupils have possible important effects upon their motivation and ability to learn, socio-economic characteristics should be controlled as carefully as possible.*

The data gathering effort was focused upon information needed to test the hypotheses just enunciated. Questions were asked concerning the amounts and types of instructional resources used as well as the coordination or "teamwork" present. Information was also gathered for several variables meant to measure socio-economic status, including mobility, racial characteristics, and percent of children in the school attendance area receiving aid to families with dependent children.[3]

STATISTICAL TECHNIQUES USED

The statistical procedure used was multiregression analysis, a technique through which it is possible to estimate the effect of one variable while at the same time holding constant the effects of other variables in the model. Since it was felt that instructional time, program coordination, and pupil socio-economic characteristics were important *a priori* as discussed above, it was important to include variables for each of these effects in the explanatory model. It was also necessary to account for the effects of program length and pupil beginning score.[4] Beyond these considerations, variables were chosen or omitted from the model on the basis of their explanatory power. Various combinations of functional forms were tried for the variables, but usually the linear form turned out to be best.

The model which was consistently best in explanatory power included the following variables:

- Beginning Score
- Program Length
- Percentage of Pupils Who Belong to a Minority Group
- Minutes of Instruction by Reading Specialists[5]
- Minutes of Instruction by Paraprofessionals Helping Regular Classroom Teachers
- Percentage of Instruction in a Separate Facility
- Hours of Planning per Week

This model was fit to pooled reading achievement data for all pupils in grades 2, 3, 4, and 5 as well as for grade 3 alone. (Grade 3 was the only single grade for which there were enough observations to allow fitting the equation separately.) For the pooled data all variables in the model had explanatory power;[6] for grade 3, however, only beginning score, program length, and specialist instruction were relating to reading gains at high probability levels.

SUMMARY OF FINDINGS

Table 1 gives the relationships of the key resource-using variables to gain in the pooled grade scores along with some cost estimates. Outcomes for other variables are listed in Table 2.

It is important to note the figures in Column 4 of Table 1, the probability that the results did not occur by chance. This gives what might be considered an estimate of the dependability of the findings, with the higher the figure, the higher the probability that we would discover a similar relationship in a different set of data. Most researchers do not feel confident about this assumption unless the probability is 90 percent, and much preferably, 95 percent. Thus the findings in Table 1 for paraprofessionals assisting the classroom teacher and use of a separate facility, while seeming to show that these inputs are efficient, are certainly not dependable enough for us to accept without strong reservations.[7]

The instructional variable which is most consistently and dependably (in the sense just mentioned) related to reading gains was that for the

trained reading specialist.[8] Indeed, as already mentioned, specialist instruction was the only school input related to reading performance in the third grade considered separately with the strength of the relationship even stronger in that grade than in the four pooled grades. While the variables for instruction by paraprofessionals were less statistically significant, they showed signs of having some importance. This was especially true for instruction by paraprofessional instruction in support of the regular classroom teacher.[9] The only instructional variable which was never related to reading gains at all was that for the regular classroom teacher. It should be noted that in the schools studied the classroom teacher usually had other responsibilities besides those to program children and typically could not devote a few *additional* minutes of instruction per week to them.

Of the variables constructed to measure planning and coordination, only that for hours of planning itself was related to performance. The socio-economic variable most related to reading gain was that denoting percentage minority (black, Spanish surname, American Indian) and even this relationship was weak. There was also a weakly significant inverse relationship between percentage of pupils in the project school who were target children and reading gain. This is further discussed below.

To summarize the foregoing results, the first two hypotheses given above are strongly supported. Minutes of instruction, especially those by the trained reading specialists, were consistently related to reading gains. The hypothesis concerning coordination is supported to the extent that we can interpret planning hours as a coordination variable, although the finding is not replicated when data for grade 3 alone are used. Finally, the variables used for home socio-economic characteristics did not reflect much difference in performance, with percentage minority and percentage target children being the only variables showing signs of being different from zero.

COST AND EFFECTIVENESS

Perhaps the best way to translate the findings of the study into results that are readily meaningful to policymakers is to present them in cost terms. This is done in Column 3 of Table 1. Presenting such

cost estimates, even if carefully constructed, is not without its dangers, and care must be taken that the figures are not interpreted too literally.[10] They are perhaps best interpreted to mean that we may entertain a reasonable hope that $100 per pupil spent on instruction by reading specialists, working alone or in some combination with paraprofessional assistants, can return in the neighborhood of an additional one-tenth of gain per month of instruction. If true, this would mean that an additional expenditure of $300 per pupil would bring these children to a learning rate near the national norm, if we use the figure of 0.7 months gain as the "normal" learning rate of pupils meant to be reached by Title I programs, as many do.[11] In situations where the present system is failing, as is often alleged to be the case in many high minority core-city schools, it might be efficient to substitute specialist instruction for relatively large amounts of traditional self-contained classroom instruction.[12]

CONCLUDING COMMENTS

It is widely believed, mostly on the basis of the reports of large national surveys, that compensatory education has "failed." The findings of this study, which demonstrate modest average success and the possibility of very respectable gains in reading if diagnostic reading specialists are used for instruction, stand in partial contradiction to this.

Supposing these findings are accurate (and this can be checked only through replication), why are the large survey results so different? I think the answer to this lies in the fact that the methodology used in such surveys has been dangerously faulty, as pointed out in a recent Rand survey of educational evaluation.[13] The most glaring defect is that they depend on results of matching program children with control groups which are probably superior. Randomly matched control groups in research designs for ongoing Title I and Headstart programs are almost non-existent and conscientious educators almost always choose children for the program who need it most. In addition, it seems reasonable to assume that "spill-over" gains from program to non-program children take place.[14] Therefore, while it is reasonable perhaps to assume that "no difference" findings from such research tell us that there are no *large* gains, it cannot be said that there are *no* gains.

On the other hand, there is increasing evidence from other compensatory education research which tends to support the findings here. Guszak discusses research which he feels gives rise to a "reasonable hunch" that instruction by diagnostic reading teachers is effective for disadvantaged pupils.[15] Bissell has shown convincingly in a careful analysis of the findings of many well-designed compensatory education research projects that better learning rates are associated with the degree of external organization and sequencing of the child's learning experiences, hierarchical organization of objectives, a directive teacher role, and the nature and amount of program supervision and personnel training.[16] These attributes are precisely those that are present with instruction by trained specialists, especially so when the program is planned such that the regular classroom teacher and paraprofessionals are well coordinated to the specialists' activity.

At the time of writing (March 1972), there is considerable national controversy over the issue of whether quality education can be given in core city schools without resorting to large bussing programs. The present study has been used by some in that controversy to imply that such schools can be greatly improved with additional resources.[17]

It is, in fact, dangerous to extrapolate the findings in this study to core city schools with one-hundred percent disadvantaged populations directly. There were six such schools in the study sample and none of the six used more than minimal instruction by reading specialists.[18] This means that we cannot extrapolate the important specialist finding to such schools directly. Of course, we still have the finding that specialist instruction is related to reading gains in general, and there is no reason to believe that it may not hold true for core city schools even though we do not have any direct evidence that it does.

There is other evidence which supports, but only weakly, the notion that program children do better in schools where their percentage is less than half of the total school enrollment. In the sample there were thirteen projects where average gain in reading was greater than one month for each month of instruction and all thirteen were projects where less than fifty percent of total school enrollment were program children. When a variable for percentage program children in the

building was used in the regression equations, it was found to be negatively related to gain although not at high levels of probability.[19] It would be incorrect to infer from this weak relationship that large gains can be scored only in buildings where less than half of the children were in the program, but the evidence does nonetheless lean slightly in that direction.

There are some logistical problems in adding large amounts of specialist instruction to one hundred percent disadvantaged core city schools also. In an inner city elementary school with 600 pupils, for example, if each pupil were to get thirty minutes of attention from a specialist weekly, about fourteen specialists would be required. This means that additional facilities equal to more than half the size of the present building will be required, by no means a minor undertaking. On the other hand, if only one-quarter or one-third of the students in a school building are program children, facilities can often be found (portable classrooms, etc.) without major disruption and expense being necessary.

One last caveat perhaps should not be necessary. The findings here are for only one subject, Reading, and then only in four elementary grades. They are not properly extrapolated to other subjects or other grades. They also have little to tell as concerning how long they will be maintained, which is undoubtedly the single most important question demanding our attention.

Table 1

Relationship of Statistically Important Resource-Using Educational Inputs to Performance on the Stanford Reading Test with Cost Calculations: California Pupils in Elementary School Title I Programs, Grades 2, 3, 4, 5

Instructional Input	Relationship to Reading Performance (Additional Gain per Month of Instruction per Ten Minutes of Instruction per Pupil per Week (Except Where Otherwise Noted)[a]	Apparent Return per $100 Spent per Pupil (Additional Gain per Month of Instruction)[b]	Probability That Result Did Not Occur by Chance
Instruction by Reading Specialists	.76 Months	.095 Months	99.4%
Instruction by Both Reading Specialists and Assisting Paraprofessionals	.068 Months	.085 Months	95.0%
Instruction by Reading Specialists with Little Instruction by Paraprofessionals Assisting Regular Classroom Teachers[c]	.071 Months	1st $100: .102 Months 2nd $100: .091 Months 3rd $100: .089 Months	92.0%
Instruction by Reading Specialists with Much Instruction by Paraprofessionals Assisting Regular Classroom Teachers[d]	.092 Months	1st $100: .178 Months 2nd $100: .106 Months 3rd $100: .094 Months	91.0%
Instruction by Paraprofessionals Assisting the Regular Classroom Teacher	.059 Months	.195 Months[e]	86.0%
Hours of Planning per Week	.219 Months per Hour of Planning per Week	Not Possible to Compute	98.0%
Instruction in a Separate Resource Facility	.021 Months per 10 Percent Instruction per Pupil per Week	.210 Months[f]	82.0%

Table 1 (Cont'd)

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[a]All gains are given in terms of the national norm of the Stanford Reading Test.

[b]It should be noted that if there are additional management costs, these must be added to the figures given. If the program is very large, an additional cost of ten percent might be realistic.

[c]This finding is for 27 projects with an average of 3.9 individual equivalent minutes by paraprofessionals assisting regular classroom teachers and a standard deviation of 3.0 minutes.

[d]This finding is for 15 projects with an average of 17.8 individual equivalent minutes of instruction by paraprofessionals assisting regular classroom teachers and a standard deviation of 7.7 minutes.

[e]The indicated return is associated with a total cost of $83 per pupil, which is the cost of 33 individual equivalent minutes of instruction, highest in the sample.

[f]The indicated return is associated with $80 per pupil per year total cost. This is based on the average number of individual equivalent minutes of instruction in the sample (44) and an assumed yearly cost of $4,000 for classroom and materials.

Assumed Costs

Costs per year for classroom teachers and specialists were assumed to be $10,000 and $12,000, respectively. These are close to the California average for such persons. Instruction by paraprofessional aides was assumed to cost $5.00 per hour. This is higher than the figure often used because I assumed that a trained specialist had to give up ten minutes of time in supervision for every 100 minutes worked by the paraprofessional.

Building cost data used were supplied by the California Department of General Services and checked against figures published by Educational Turnkey systems in Audiovisual Instruction Magazine, November 1971. The figure obtained for special classroom and facilities serving 20 children per hour was about $3,000 per year. $1,000 was arbitrarily added to this to account for land costs and any other miscellaneous expenses. Also assumed was forty-year life and a six percent interest rate.

Table 2

The Relationship of Non-Resource Using or Non-Statistically Important Variables in the California Title I Study, by Relationship to Reading Gain[a]

Variables Related to Gain in Reading Score
Program Length in Months from Pre-Test to Post-Test
Average Score on Stanford Reading Test, All Program Children, Beginning of Program
Percentage of Program Children American Indian, Black, or Spanish Surname (Pooled Grades at the .85 Probability Level Only)
Percentage of Children in the School Building Who Are Title I Target Children (The .80 Probability Level Only)
Variables Not Related to Gain in Reading Score
Minutes of Instruction per Week by the Regular Classroom Teacher (Beyond the Normal Program)
Hours per Week of Formal[b] In-Service Training by Instructional Personnel
Dummy Variable for Whether or Not All Project Personnel Were Ultimately Directed by a Single Manager
Dummy Variable for High and Low Use of a Full-Time Psychologist for Diagnosis
Percentage of Pupils in Program at Beginning of Year Still Present at End of Program Year
Percentage of Pupils in School Attendance Area Who Received Aid to Families With Dependent Children

[a] A fuller description of the variables as well as the means and standard deviations for most of them is contained in the original report, pp. 17-25.

[b] This variable did not include informal (but highly important) instruction in the nature of on-the-job training given by specialists and classroom teachers to paraprofessionals. This omission, plus the fact that specialists have thorough training in individualized instruction while other personnel do not, could account for the non-significance of this variable.

FOOTNOTES

1. H. J. Kiesling, *Input and Output in California Compensatory Education Projects*, The Rand Corporation, R-781-CC/RC, Santa Monica, California, 1971.

2. The sample was chosen on a stratified random basis subject to the limitation that only projects which employed the Stanford Reading Test were considered for use. These accounted for about one third of all California projects in the 1969-70 school year. I know of no *a priori* reason why this limitation may have made the sample unrepresentative of the state. Stratification criteria used in sample selection were the percentage of children in the school attendance area receiving aid to families with dependent children (AFDC), percentage black, and percentage with Spanish surnames.

3. The questionnaire used is published as an appendix to the original report.

4. See original report, pp. 17-18 and 48.

5. The minutes of instruction variable was constructed to have a common denominator of the number of minutes of instruction each child received *per week* on an individual equivalent basis. The following is an example of how the variable was constructed. If a single specialist saw groups of 10 pupils 30 minutes per day five days per week, Individual Equivalent Minutes (IEM's) would be 15 (30 divided by 10 times 5). If the specialist has one paraprofessional assistant for these ten pupils, IEM's for each, abstracting from supervision time, doubles. Since it is assumed that the specialist and the paraprofessional both lose ten percent of their time in the specialist's supervision of the paraprofessional, IEM's for each was computed to be 13.5 and not 15. The convention used to account for time taken in supervision was to deduct ten percent of the instructional time of supervising teacher and paraprofessional for each of the first two paraprofessional aides, and five percent for each aide after that.

6. Appendix B in the original report contains a discussion of the strengths and weaknesses of using pooled grade data.

7. The probability for paraprofessional instruction assistance of the classroom teacher is conservatively stated, however. See the discussion in the next paragraph.

8. This finding fits some *a priori* notions enunciated in a paper by F. J. Guszak: "The Diagnostic Reading Teacher for the Disadvantaged Child," in J. L. Frost and G. R. Hawkes (eds.), *The Disadvantaged Child*, Houghton-Mifflin, Boston, 1970, pp. 361-378.

9. The statistical significance given in Table 1 for this variable is conservatively stated because the variable was significant at higher

probability levels in some alternative model specifications besides the one used.

A slight error in the original report should be noted here. When the logarithm of the specialist instruction is used, a problem exists with zero values, since log 0 = -00. No matter what convention is used to deal with this, the instruction variable for paraprofessionals helping classroom teachers is statistically significant at the 97 percent level. However, when the linear form of the specialist variable is used significance drops to 75 percent. In Table 1 the value used was an average of these two findings. The convention used for zero values in the original report overstates the functional relationship of the specialist variables (especially near zero) and if the linear form is correct, overstates the paraprofessional variable somewhat as well. In this paper the conservative choice was always made when there was some doubt about which functional form of the model was best.

10. In no statistical exercise such as this study can cause and effect relationships be inferred with certainty. This can only be approached in the controlled experiment. This means that there is always the possibility that the relationships found might in fact be explained by the influence of forces not being studied. As an example in the present study, perhaps pupils in projects having more specialist instruction also happen to be members of families where there is more sophisticated verbal interaction. The cause of better reading gains is (undetected) differences in family circumstances and not specialist instruction at all: our conclusion is erroneous.

    Upon careful reconsideration of the data for possible alternative explanations for the relationship between specialist instruction and reading gain, I could find none that seemed plausible. One possibility had to do with the fact that central city schools had little specialist instruction and also performed poorly (see also the concluding section). But while it is true that inner city schools did not use specialists heavily, only two out of seven such schools were very far below the mean (one was slightly above). Besides this, regressions for the 35 non-inner city schools still showed the specialist variable to be highly significant statistically. A range of possibilities involving socio-economic differences in the home were also considered. If these are related to any other socio-economic characteristics which I was able to collect formally or notice informally, the possibility that this explanation is true also seems small.

11. The Coleman Report found an average gain of 0.75 months for children *who had not dropped out*. Wargo and associates assume a rate of 0.67 months gain per month of instruction.

12. If Title I children, 20 to a classroom, were to be given individualized instruction by diagnostic specialists three hours a day instead of traditional instruction where there are 30 pupils in a self-contained classroom, I calculate the difference in cost per pupil per year at $200 at most. This includes the cost of two additional classrooms, additional diagnostic and instructional materials, and the use of one

paraprofessional assistant to the specialist. It also assumes, of course, that the regular classroom teacher is used profitably elsewhere.

13. H. A. Averch. S. J. Carroll, T. S. Donaldson, H. J. Kiesling, J. Pincus, *How Effective Is Schooling?* The Rand Corporation, R-956-PCSF/RC, 1972, Chapter 6.

14. See the discussion of the findings by Gray and Klaus in *ibid.*

15. *Op. cit.*

16. Joan S. Bissell, *The Cognitive Effects of Pre-School Programs for Disadvantaged Children*, Unpublished Doctoral Dissertation, Harvard University Libraries, 1970.

17. See Testimony of Secretary Elliot Richardson before the Sub-Committee on Education, Committee on Labor and Public Welfare, U.S. Senate, March 24, 1972, pp. 32-33.

18. One had 21 minutes of instruction per child per week and the other five all had less than ten. Also see the note ten above.

19. The probability that the coefficients obtained were different from zero was about .80.

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